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Assessment of the Newfoundland Snow Crab, Chionoecetes opilio, Fishery - 1989

by

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Abstract

Catch effort data from sixteen crab management areas are presented along with size frequency/shell condition histograms for 10 of these areas. Reproductive status of female snow crab (Chionoecetes opilio) from Bonavista Bay and northeastern Avalon is compared, and a summary of carapace width versus chela height from research samples collected from four areas is presented.

Résumé

On présente ici des données sur l'effort de pêche dans seize zones de gestion du crabe ainsi que des histogrammes sur la fréquence des tailles et la condition des carapaces dans dix de ces zones. On compare la reproduction chez les crabes des neiges (*Chionoecetes opilio*) femelles de la baie de Bonavista et du nord-est de la péninsule d'Avalon et on établit un sommaire des comparaisons entre la largeur de la carapace et la hauteur des chélipèdes d'échantillons prélvés dans quatre zones.

105-04589/

Introduction

The Newfoundland snow crab (Chionoecetes opilio) fishery began in 1968 at Hant's Harbour, Trinity Bay. Development of this fishery proceeded at a moderate pace until the late 1970's when increased demand, processing and harvesting capacity stimulated a rapid increase in landings until 1982. Since then the fishery in the Southern Zone, until recently, has been in a state of collapse due to a combination of overexploitation, indicated by declining catch rates and a failure of recruitment mechanisms within the snow crab population.

Coincident with the decline of the snow crab fishery in the Southern Zone, was an expansion of the fishery in the Northern Zone. Although this expansion was rapid beginning in 1982, it proved to be brief and ended in 1985. At present, the Newfoundland snow crab fishery remains in a state of collapse in many inshore areas of the Northern Zone, while in most areas of the Southern Zone and in 3Ps the fishery is stable or expanding due to increased resource availability.

A blow to the stability of the fishery was the cancellation of the regulation prohibiting the retention of soft-shelled ("white") crabs in 1986 (Taylor and O'Keefe 1987). As most of the molting activity in the Newfoundland Region takes place during the commercial fishing season (April-December) the dropping of this regulation has resulted in fishermen landing both hard- and soft-shelled animals. This de facto mid-season recruitment into the fishery has rendered Leslie analysis useless as an assessment tool in all management areas that experience such a mid-season pulse of molting. As this phenomenon is common throughout the Northern Zone and the deep water bays of the Southern Zone, we are once again restricted to considering comparative catch/effort and available size-frequency/shell condition data as a means of assessing the general "health" of snow crab stocks.

In 1986 Resource Management Branch imposed quotas on all management zones. These quotas were loosely based on 1985 landings, but in areas where exploitation rates were excessive, quotas were reduced. While quotas were overfished in several areas, this management initiative must be viewed as a positive step. Again in 1989, as in all previous years, Resource Management Branch utilized quotas in order to limit fishing effort and exploitation rates.

Although supplementary crab licences were first issued in the Northern Zone in 1985 resource managers declined to issue similar licences in the Southern Zone citing resource conservation and the failure of the fishery in some management areas. However, in 1988 supplementary licences were issued in all inshore areas of the Newfoundland Region, making the crab fishery a "two fleet fishery".

While there remains a "core" of 71 full-time vessels, these fishing enterprises are now more restricted than in previous years. In the Northern Zone all large full-time vessels have been licenced for the offshore (Area 4) only, while a portion of the fleet, those with smaller, older vessels, are treated in the same fashion as supplementary vessels, retaining only their right to fish 800 traps. Similarly in the Southern Zone full-time vessels except those from Bonavista Bay, have been excluded from fishing in any individually managed bay area. A summary of licences by zone is presented in Table 6.

Materials and Methods

In 1988 Fisheries Statistics and Systems Branch would use snov crab management areas as well as the standard NAFO subareas for the first time. Because of this arrangement, and the increased number of licenced vessels participating in the fishery, ve abandoned the laborious process of analyzing all logbook data independently. Three to five vessels from each management area were randomly selected by us and their logbook/sales slip data analyzed to provide an independent estimate of mean CPUE for each area.

In addition to an examination of catch/effort data, several research cruises were conducted using standard crab traps fished at randomly selected locations on the commercial fishing grounds in the Southern Zone. Catches were analyzed and size frequency/shell condition histograms for various management areas (Fig. 1 and 2) were drawn. These histograms are presented in Figures 3-6.

Sampling of commercial catches was conducted on an opportunistic basis. Size/frequency-shell condition histograms for areas from both the Northern and Southern Zones are presented in Figures 7-13.

At the request of CAFSAC Steering Committee a review of current management areas was undertaken in 1986 with the aim of reducing the total number of 'assessments' performed each year. While this early attempt was successful in terms of combining areas by biological criteria, from a regulatory perspective the proposed management area revisions were unusable.

A second attempt was initiated in the fall of 1988 in collaboration with appropriate Departmental representatives through the internal "Snov Crab Working Group". The result of this effort is illustrated in Figure 2. A 'key' designed to aid the reader in converting from old management areas (Fig. 1) to nev management areas (Fig. 2) is provided in Table 9.

Results and Discussion

CPUE data presented in Tables 1 and 2 are based on the analyses of catch/effort data for three to five vessels per management area. All landings data presented in Tables 1 and 2 are based on the 1989 quota report and are summarized in Table 3. Historical landings provided in Tables 1 and 2 were summarized in accordance with the revised management areas (Fig. 2, Table 9).

Southern Zone

The 1989 fishery was successful in most areas of the Southern Zone. Examination of Table 3 indicates that landings decreased from 5903 t in 1988 to 4985 t in 1989 primarily due to declining catches in area 8 and tighter control of quota overruns in other areas. Of particular note is the resurgence of the fishery in the offshore (Area 7B) (Table 1). The supplementary fishery in this Zone was again prosecuted in 1989 and was hailed as having been of great benefit by most participants. The major negative aspect of the fishery in this Zone, was the high incidence of soft-shelled crabs encountered during the fall supplementary fishery. The high degree of quota overrun experienced in 1988 was not repeated in 1989. The overall status of the snov crab resource in this zone (area 8 excepted) can be described as stable or improving slightly depending on the area under consideration.

St. Mary's Bay (Area 9)

In 1988, the fishery in this area was closed to full-time licences and a 200 t quota allocated to the supplementary fleet. Due to severe problems encountered with soft-shell crabs the fishery was closed shortly after the initial opening in order to allow crabs to harden to an acceptable condition. This scenario was repeated in 1989. Catch rates are comparable to those experienced in 1988 (Table 1) while the reduced landings are indicative of more efficient quota monitoring in 1989. Port sampling conducted during the supplementary fishery in September (Fig. 7, Table 5) indicates that most of the catch consists of soft or new/hard crabs just over the minimum legal size.

Southern Avalon (Area 8)

This area continues to be heavily fished. The reduction in CPUE and landings is attributed to the transfer of highly productive fishing grounds in the southwest corner of the management area to the 3Ps fishery. In addition, for the first time in 1989 fishery officers were placed onboard commercial crab vessels in an effort to ensure that effort restrictions (800 traps) were adhered to. This may have reduced misreporting of effort which normally tends to inflate CPUE values. Commercial plant sampling (Fig. 8, Table 5) indicates that the majority of the catch from this area consisted of new/hard animals.

Eastern Avalon (Area 6C)

Landings in this area were reduced from 1988 levels reflecting tighter quota control. Sub-legal individuals dominated the May research cruise catch (Fig. 5) but as in 1988, almost all animals sampled were in a new/hard shell condition. CPUE in 1989 was slightly reduced from 1988 levels (Table 1).

Offshore Avalon (Area 7B)

CPUE in this area in 1989 was virtually identical to that experienced in 1988 while landings increased from 298 t to 519 t. Comparable catch rates were not experienced during a spring research cruise possibly due to the fact that the cruise was coincident with the inshore migration of capelin which may have affected crab catchability. Trap caught crabs sampled during this survey were mostly sub-legal or immediate post-recruits (Fig. 3). Commercial plant sampling of this area conducted in September indicates that molting had occurred during the commercial fishing season (Fig. 10 Table 5).

Downing Basin (Area 7C)

Catch rates declined from 10.5 kg to 7.2 kg with only one vessel prosecuting the fishery in this area in 1989. The off-shore research cruise conducted in June extended to this area. Catch rates experienced during the cruise were extremely low, again possibly due to the inshore capelin migration. Size-frequency histograms compiled from trap-caught individuals during this cruise indicate a high degree of molting activity and an abundance of sub-legal males (Fig. 4).

Conception Bay (Area 6B)

Catch rates decreased in this area to 6.1 kg/trap haul (Table 1), the lovest since 1986. This reduction in CPUE can be attributed to a strict prohibition placed on soft-shelled crab by processors. Soft-shell became such a severe problem during the September supplementary fishery that a mid-season closure of the fishery was imposed at the request of all participants. Fishery officers report that at least 100 t was dumped by processors (applied against the quota) and perhaps twice that amount dumped at sea by fishermen (not applied against the quota). At least 120 fishermen participated in the fishery in Conception Bay. Plant sampling conducted in September indicates that most of the catch was new/hard or soft-shelled (Fig. 9).

Trinity Bay (Area 6A - inner portion, Area 7A - outer portion)

Landings increased in both areas of Trinity Bay. CPUE in the inner portion of the bay increased slightly while catch rates in the outer portion of the bay remained unchanged (Table 1).

Bonavista Bay (Area 5)

The fishery in this area appears to have stabilized with landings and CPUE at similar levels to those experienced in 1988 (Table 1).

The fishery is predominantly fished by full-time vessels but a 300 t quota (Table 4) was allocated to a supplementary fall fishery in 1989. A yearly time-series cruise conducted in August of 1989 indicates a high degree of molting activity (Fig. 6).

Northern Zone

Most management areas in this zone are continuing to experience extremely lov catch rates as a result of excessive fishing pressure (Taylor and O'Keefe 1988). Despite a reduction in overall quota from 4000 t to 2550 t in 1988 catch rates in 1989 rose only modestly in areas 3C and 3D (Notre Dame Bay and Fogo-Twillingate respectively), and remained unchanged from 1988 levels in a third, area 3B (White Bay) (Table 2). Virtually all fishermen reported a very high incidence of soft-shell crab during most of the fishing season.

Prior to the opening of the 1988 fishery season Fisheries and Habitat Management Branch divided the Northern Zone into an inshore and offshore zone, areas 3 and 4 respectively. The inshore consists of those areas within 30 n mi of land, while the offshore zone extends from 30 n mi to the boundary of NAFO Area 2J. Full-time fishermen with a history of fishing the inshore zone were permitted to remain in these areas or opt for fishing the offshore zone thus relinquishing their right to prosecute the inshore fishery.

Catch rates and landings rose slightly in 1989 due to the discovery by the commercial fishing fleet of new areas of resource abundance northeast of the Funk Islands. Fishermen claimed that catch rates in this area were extremely good, exceeding 30 kg/trap haul. The extent of these new grounds is unclear as the fishery closed soon after their discovery. An area by area review of Northern Zone catch rates is presented in Table 2.

Commercial catch sampling during the fishing season found that catches consisted largely of new/hard and soft-shell crabs (Table 5, Fig. 11-13).

Labrador

The snow crab fishery began in Labrador (Area 2) on an experimental basis in 1985. During 1985 and 1986 the fishery was predominantly prosecuted by Southern Zone vessels in order to determine the extent of the crab resource. In 1987 an attempt was made by Fisheries and Habitat Management Branch to transfer the crab licences to local Labradorians who had been schooled in the "art" of crab fishing by experienced Southern Zone fishermen. For various reasons this technology transfer did not go as smoothly as all parties would have liked. As a result, fishing effort was somewhat sporadic and concentrated more in inshore areas than in the two previous years.

In 1989, the Labrador fishery was prosecuted by both Labradorians and fishermen from the island portion of the province. Overall catch rates and landings improved over 1988 levels even though the area fished is somewhat restricted. Fishermen encountered severe problems with soft-shell crab indicating a high incidence of molting in the area.

In 1989 an exploratory charter sponsored by DFO Development Branch discovered an extensive area of commercial quantities of snow crab north of 54.00 degrees latitude. Catch rates exceeding 25 kg/trap haul were quite common over a large area. The feasibility of developing the obvious commercial potential of this resource is presently being examined by a federal-provincial committee.

3Ps

The fishery in this area is exclusively supplementary. In order to accommodate the groundfish and lobster fisheries which are the mainstay of the local economy the snow crab fishing season is divided into spring (May 1-June 15) and fall (September 1-October 31) with a total quota of 600 t. This quota is divided (spring - 200 t, fall - 400 t) in a manner determined by local fishermen's committees in consultation with officials from Fisheries and Habitat Management Branch.

Much of the fishing activity in this areas is now concentrated at the mouth of Placentia Bay as fishermen exploit the resource previously fished by vessels from area 8.

Reproductivity Capacity

Time-series research cruises were again conducted in two areas, (Areas 6C and 5) during 1989. Samples of females were collected using small meshed (40 mm stretch measure) traps and examined macroscopically both internally and externally in order to determine reproductive status. Results of these examinations are summarized and presented in Table 7.

As in previous years, approximately 100% of mature females are berried. The phenomenon of primiparous females bearing eggs but having "empty" spermathecae (macroscopic examination only) was again seen in 1989. Laboratory experiments monitoring egg development are ongoing but continue to be plagued by failures of the seawater system at NAFC.

Chela height/Carapace Width Relationships

In 1987 data were first collected in order to investigate components of the male snow crab population that are categorized by the relationship between chela height and carapace width. While the significance of the differentiation of males into small-clawed and large-clawed groups remains the subject of debate, variations in yearly chela/carapace width relationships may provide interesting insights into snow crab population dynamics.

Plots comparing chela-height carapace width relationships for 1988 and 1989 are presented for Inshore Avalon Peninsula and Bonavista Bay in Figures 14 and 15 respectively. In addition, data for the Offshore Avalon Peninsula and the Downing Basin for 1989 are presented in Figures 16 and 17 respectively.

Summary

While the fishery in most areas of the Southern Zone appears to be recovering, as indicated by improved catch rates and increased landings, the fishery in the inshore areas of the Northern Zone remains at a low level. The high incidence of soft-shell crab in the Northern Zone indicates that normal recruitment mechanisms appear to be functioning but yearly growth and recruitment are not sufficient to rebuild snow crab populations at current exploitation rates.

References

Taylor, D. M., and P. G. O'Keefe. 1987. Analysis of the snow crab (Chionoecetes opilio) fishery in Newfoundland for 1986. CAFSAC Res. Doc. 87/57. 26 p.

Taylor, D. M., and P. G. O'Keefe. 1988. Analysis of the snow crab (Chionoecetes opilio) fishery in Newfoundland for 1987. CAFSAC Res. Doc. 88/62. 27 p.

Table 1. Summary of available statistics for the Newfoundland snow crab fishery (Southern Zone), 1980-89. Beginning in 1985 projected effort is presented. The CPUE is calculated from logbook data of 3 to 5 randomly selected crab vessels from each area.

Area	Year	Effort (trap hauls)	Landings (t)	CPUE (kg/trap haul)
10	1985	-	602	-
(3Ps)	1986	-	651	-
	1987	199,000	596	3.0
	1988	231,000	856	3.7
	1989	112,553	529	4.7
9	1981	11,150	168	15.0
	1982	48,350	506	10.5
	1983	37,780	274	7.3
	1984	35,400	264	7.5
	1985	23,100	164	7.1
	1986	21,250	102	4.8
	1987	690	4	5.8
	1988	36,924	266	7.2
	1989	29,726	217	7.3
8	1980	13,825	292	21.1
	1981	45,455	854	18.9
	1982	49,975	732	14.7
	1983	102,360	998	9.7
	1984	154,583	1,243	8.0
	1985	131,827	1,012	7.7
	1986	208,527	2,197	10.5
	1987	169,041	1,894	11.2
	1988	223,037	2,347	10.5
	1989	197,590	1,640	8.3
7C	1982	7,295	114	15.6
	1983	61,089	733	12.0
	1984	41,080	397	9.7
	1985	-	-	-
	1986	-	-	-
	1987	-	-	-
	1988	47,619	500	10.5
	1989	11,389	82	7.2

Table 1. Continued...

Area	Year	Effort (trap hauls)	Landings (t)	CPUE (kg/trap haul)
6C	1980	242,277	5,065	20.9
	1981	459,056	7,607	16.6
	1982	252,507	3,368	13.3
	1983	96,390	677	7.0
	1984	56,030	312	5.6
	1985	24,343	113	4.6
	1986	26,776	144	5.4
	1987	29,793	172	5.8
	1988	71,970	751	10.4
	1989	68,144	661	9.7
6B	1980	56,393	869	15.4
	1981	43,546	502	11.2
	1982	60,753	694	11.4
	1983	64,175	564	8.8
	1984	52,330	333	6.4
	1985	26,060	139	5.3
	1986	32,620	193	5.9
	1987	24,674	227	9.2
	1988	44,955	499	11.1
	1989	78,033	476	6.1
7B	1981	65,978	1,840	28.0
	1982	218,356	4,194	19.2
	1983	150,432	1,662	11.0
	1984	47,845	431	9.0
	1985	5,955	31	5.2
	1986	-	-	-
	1987	-	-	-
	1988	39,733	298	7.5
	1989	68,289	519	7.6
6A	1980	4,550	59	12.9
	1981	14,970	110	7.4
	1982	10,535	65	6.1
	1983	12,120	72	6.0
	1984	2,464	17	6.9
	1985	4,980	19	3.8
	1986	3,420	18	5.1
	1987	8,980	44	4.9
	1988	22,791	98	4.3
	1989	35,294	180	5.1

Table 1. Continued...

Area	Year	Effort (trap hauls)	Landings (t)	CPUE (kg/trap haul)
7A	1980	58,160	494	8.5
	1981	24,782	178	7.2
	1982	13,755	95	6.9
	1983	20,065	107	5.3
	1984	38,240	202	5.3
	1985	27,560	113	4.1
	1986	56,897	165	2.9
	1987	36,842	140	3.8
	1988	39,216	200	5.1
	1989	51,224	251	4.9
5	1980	191,754	1,905	9.9
	1981	171,685	1,376	8.0
	1982	96,330	905	9.4
	1983	205,353	1,101	5.4
	1984	248,962	1,277	5.3
	1985*	251,720	1,015	2.9
	1986	140,870	648	4.6
	1987	83,222	602	7.1
	1988	115,122	944	8.2
	1989	112,824	959	8.5

* 287 t of soft-shelled crab subtracted from 1,015 t to calculate the CPUE

Table 2. Summary of available statistics for the Newfoundland snow crab fishery (Northern Zone), 1980-89. Beginning in 1985 projected effort is presented. The CPUE is calculated from logbook data of 3 to 5 randomly selected crab vessels.

Area	Year	Effort (trap hauls)	Landings (t)	CPUE (kg/trap haul)
3D	1983	191,307	1,857	9.7
	1984	164,211	1,463	8.9
	1985*	141,276	1,063	7.5
	1986	165,763	895	5.4
	1987*	83,026	424	5.1
	1988	164,503	800	4.9
	1989	75,296	410	5.4
3C	1980	33,261	374	11.2
	1981	54,416	650	11.9
	1982	130,305	1,352	10.4
	1983	88,288	537	6.1
	1984	76,491	502	6.6
	1985*	81,139	476	5.9
	1986	246,842	938	3.8
	1987*	112,222	303	2.7
	1988	127,500	255	2.0
	1989	69,429	243	3.5
3B	1980	24,577	254	10.3
	1981	39,090	552	14.1
	1982	84,264	1,153	13.7
	1983	240,376	2,474	10.3
	1984	354,541	3,048	8.6
	1985*	262,604	1,336	5.1
	1986	396,076	1,353	3.4
	1987*	157,517	418	2.7
	1988	180,142	387	2.1
	1989	98,095	206	2.1
3A	1989	4,583	11	2.4
4	1984	11,035	67	6.1
	1985*	40,420	225	5.6
	1986	108,732	772	7.1
	1987*	108,000	594	5.5
	1988	184,098	1,123	6.1
	1989	228,955	1,534	6.7
2	1985	20,419	311	15.2
	1986	39,695	467	11.8
	1987	30,060	256	8.5
	1988	48,495	451	9.3
	1989	50,288	523	10.4

* supplementary licenced vessels are not included in the 1985 and 1987 landings and effort for the Northern Zone except Labrador

Table 3. Summary of performance of Newfoundland snow crab fishery, 1980–1989.

Year	Southern Zone		Northern Zone		Labrador		3Ps		Total Newfoundland	
	Catch (t)	Effort ('000 trap hauls)	Catch (t)	Effort ('000 trap hauls)	Catch (t)	Effort ('000 trap hauls)	Catch (t)	Effort ('000 trap hauls)	Catch (t)	Effort ('000 trap hauls)
1980	8190	527	628	58	–	–	–	–	8818	585
1981	12636	808	1202	94	–	–	–	–	13838	902
1982	10673	762	2505	215	–	–	–	–	13178	977
1983	6188	745	4868	520	–	–	–	–	11056	1265
1984	4476	679	5080	606	–	–	–	–	9556	1285
1985	2605	496	3953	670	311	20	602	–	7471	1186
1986	3467	490	3958	917	467	40	651	–	8543	1447
1987	3083	552	2656	730	256	30	596	199	6591	1511
1988	5903	641	2565	656	451	48	856	231	9775	1576
1989	4985	653	2359	477	523	50	529	113	8396	1293

Table 4. Summary of Canadian Atlantic Quota Report for the Newfoundland snow crab fishery 1988 compared to 1989.

Management zone	Quota allocated (t)		Reported landings (t)		Amount over/under quota (%)	
	1988	1989	1988	1989	1988	1989
Labrador	926	920	451	523	under 475 (51)	under 397 (43)
Northern Zone (full-time)	1900	1620	1398	1670	under 502 (26)	under 50 (3)
(suppl.)	650	730	1167	689	over 517 (80)	under 41 (6)
Bonavista Bay (full-time)	600	600	735	639	over 135 (23)	over 39 (7)
(suppl.)	100	300	209	320	over 109 (109)	over 20 (7)
Trinity Bay (full-time)	75	-	76	-	over 1 (1)	-
(suppl.)	200	200	222	180	over 22 (11)	under 20 (10)
Outer Trinity Bay (full-time)	-	200	-	231	-	over 31 (16)
(suppl.)	-	100	-	20	-	under 80 (80)
Conception Bay (full-time)	75	-	211	-	over 136 (181)	-
(suppl.)	200	500	288	476	over 88 (44)	under 24 (5)
St. Mary's Bay (suppl.)	200	200	266	217	over 66 (33)	over 17 (9)
Southern Zone (full-time)	2300	2400	2897	2182	over 597 (26)	under 218 (9)
(offshore)	500	1000	798	601	over 198 (40)	under 399 (40)
(suppl.)	200	500	201	119	over 1 (-)	under 381 (76)
3Ps (suppl.)	600	600	856	529	over 256 (43)	under 71 (12)

Table 5. Summary of shell condition of commercially sampled snow crab, Chionoecetes opilio, 1988-89.

Management area	1988					1989				
	Month	No. sampled	% soft shell	New/hard shell	Old/hard shell	Month	No. sampled	% soft shell	New/hard shell	Old/hard shell
8	n/a	n/a	n/a	n/a	n/a	Sept	235	22.1	68.9	9.0
10	May	1336	0.1	84.0	15.9	June	412	0.2	84.5	15.3
16	n/a	n/a	n/a	n/a	n/a	Sept	396	21.7	68.9	9.4
19	August	313	1.3	85.3	13.4	Sept	502	12.2	77.7	10.1
25	Sept	404	3.2	90.8	5.9	Sept	1027	0.2	91.2	8.6
30	July	235	27.2	44.7	28.1	Sept	373	16.9	80.7	2.4
32	n/a	n/a	n/a	n/a	n/a	Sept	375	8.0	88.8	3.2
36	July	269	1.1	87.4	11.5	Sept	406	18.2	71.7	10.1

Table 6. Summary of licences prosecuting the snow crab, Chionoecetes opilio, fishery, Newfoundland Region, 1988-89.

Zone	# Full-time		# Supplementary		Total	
	1988	1989	1988	1989	1988	1989
Labrador	5	5	1	7	6	12
Northern Zone	25	26	184	201	209	227
Southern Zone	41	40	286	303	327	343
3Ps	0	0	75	106	75	106
Total	71	71	546	617	617*	688*

* While not all licenced vessels participated in the fishery, an accurate figure of total participants is not available.

Table 7. Summary of reproductive status of female snow crab, Chionoecetes opilio, in two management areas in Newfoundland, 1984-89.

Area	Year	Month	# in sample	% berried females	Spermataphore type			
					% Old	% New	% Both	% None*
Inshore Avalon	1984	May	37	100	97	-	3	0
	1985	June	55	89	42	4	54	0
	1986	June	60	98	70	7	3	20
	1987	July	53	98	56	6	34	4
	1988	June	553	94	30	26	12	32
	1989	May	258	91	25	6	17	52
Bonavista Bay	1984	August	131	99	22	1	77	0
	1985	August	106	100	8	22	70	0
	1986	August	83	100	35	25	8	31
	1987	August	134	99	27	22	41	10
	1988	August	322	100	36	19	29	16

* most females without spermatophores macroscopically evident were primiparous

Table 8. Performance of Newfoundland snow crab, Chionoecetes opilio, fishery under quota management, 1986-89.

Management areas	1986			1987			1988			1989		
	Quota (t)	landings (t)	CPUE	Quota (t)	landings (t)	CPUE	Quota (t)	landings (t)	CPUE	Quota (t)	landings (t)	CPUE
Labrador (2)	925	467	11.8	925	256	8.5	926	451	9.3	920	523	10.4
Northern[1]	4000	3958	3.7	4000	2656	3.7	2550	2565	3.9	2350	2359	4.9
Bonavista Bay (5)	500	648	4.6	500	602	7.1	700	944	8.2	900	959	8.5
Trinity Bay (6A/7A)	200	183	3.0	100	184	4.0	275	298	4.8	500	431	5.0
Conception Bay (6B)	200	193	5.9	200	227	9.2	275	499	11.1	500	476	6.1
Southern Zone[2]	2400	2443	9.5	2000	2070	11.0	3000	4162	9.6	4100	3119	8.3
3Ps (10)	600	651	-	600	596	3.0	600	856	3.7	600	529	4.7

[1] Management Areas 3A,3B,3C,3D,4
[2] Management Areas 6C,7B,7C,8,9

Table 9. Conversion of old snov crab managment areas to nev areas, 1989.

	Old	Nev
Southern Zone	2	11
	4, 6, 10	10
	8	9
	12	8
	13	7C
	14, 15, 18	6C
	16	6B
	19	7B
	20	6A
	22	7A
	25	5
Northern Zone	28, 30	3D
	32	3C
	34, 36, 38	3B
	-	3A
	40	4
	41	2

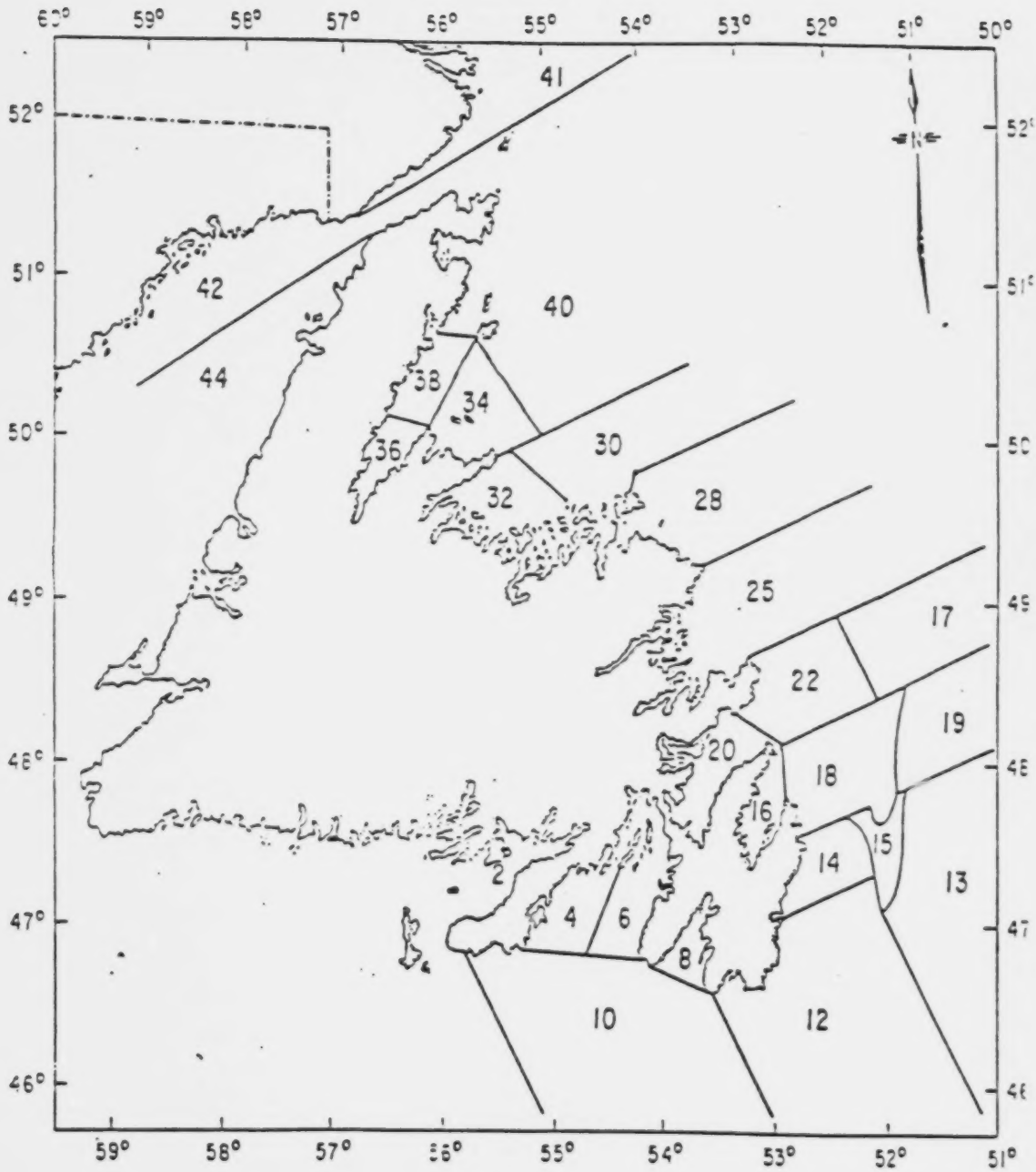


Fig. 1. Newfoundland snow crab management areas.

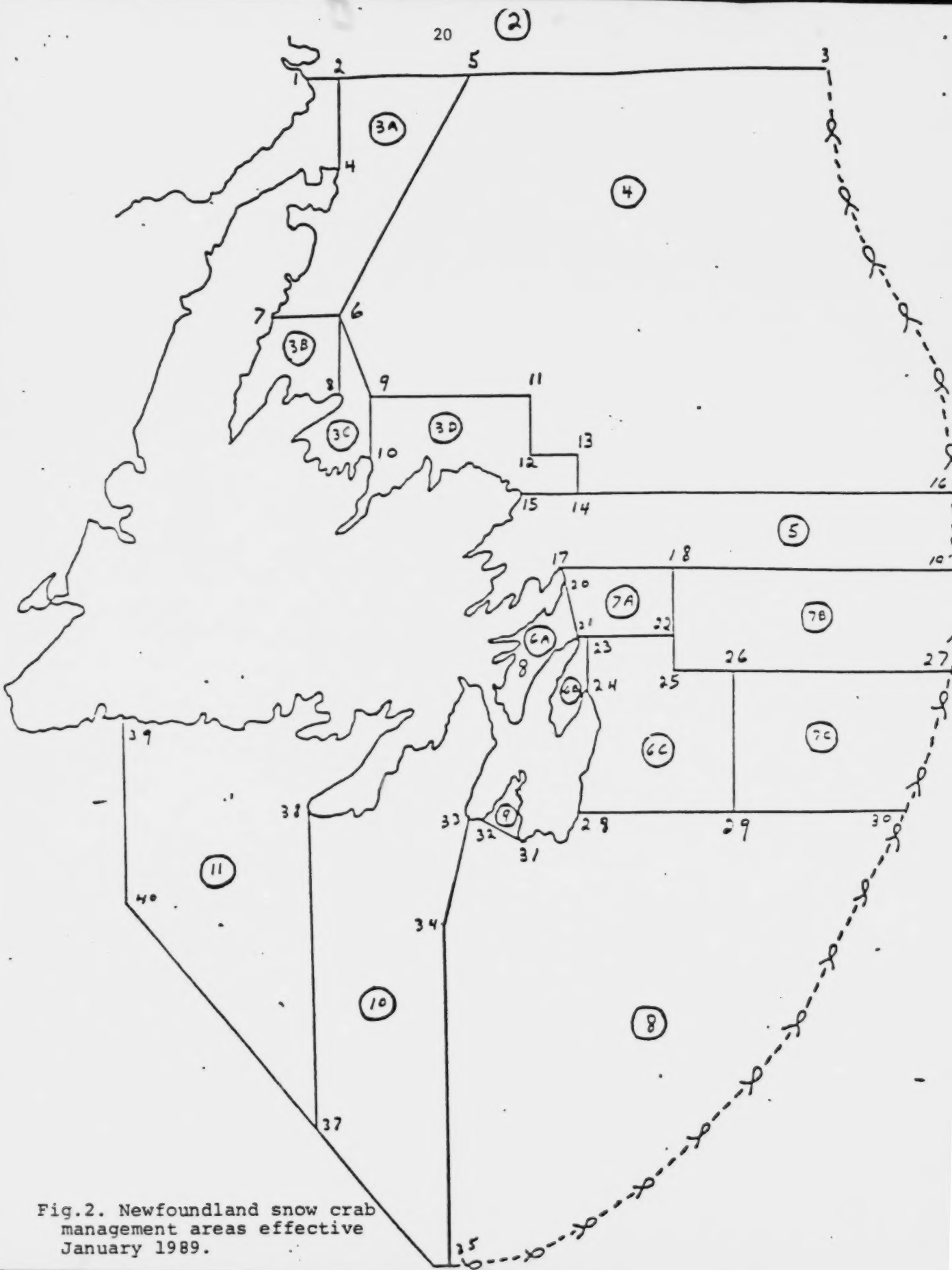


Fig.2. Newfoundland snow crab management areas effective January 1989.

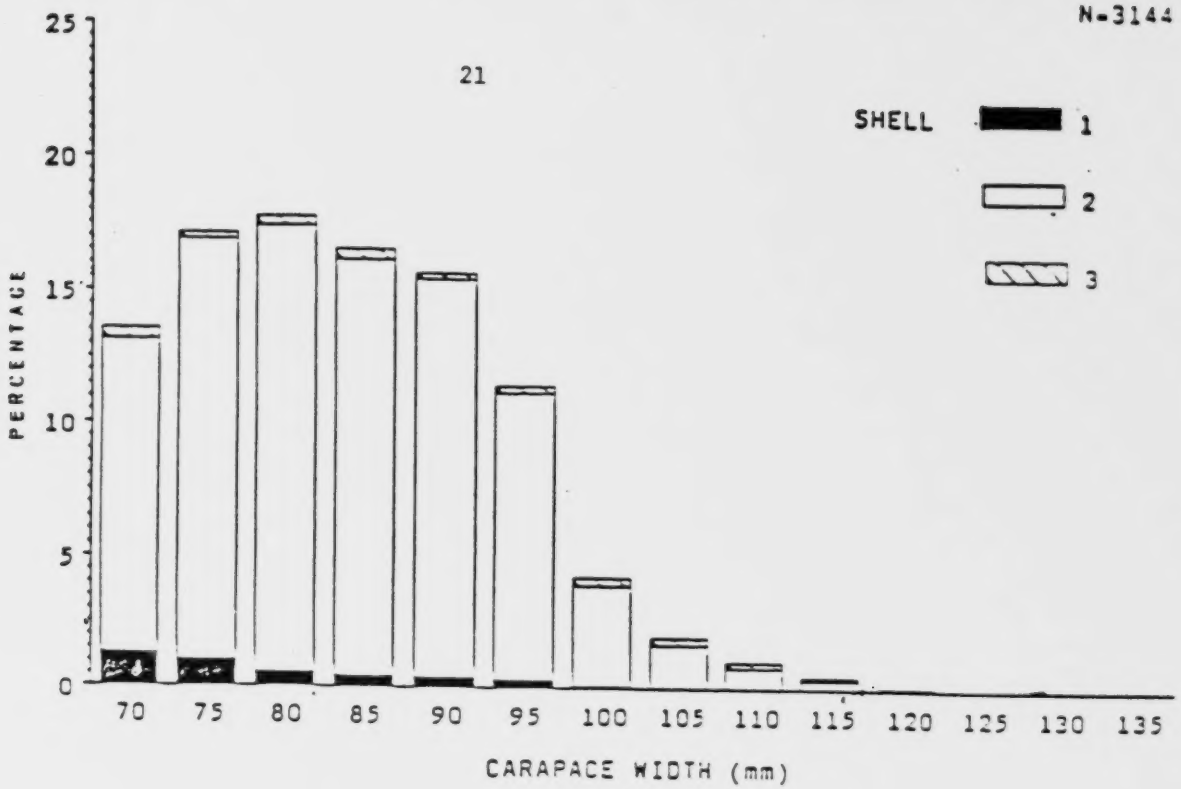


Fig.3. Snow crab research sample from offshore Avalon Peninsula, May 1989.

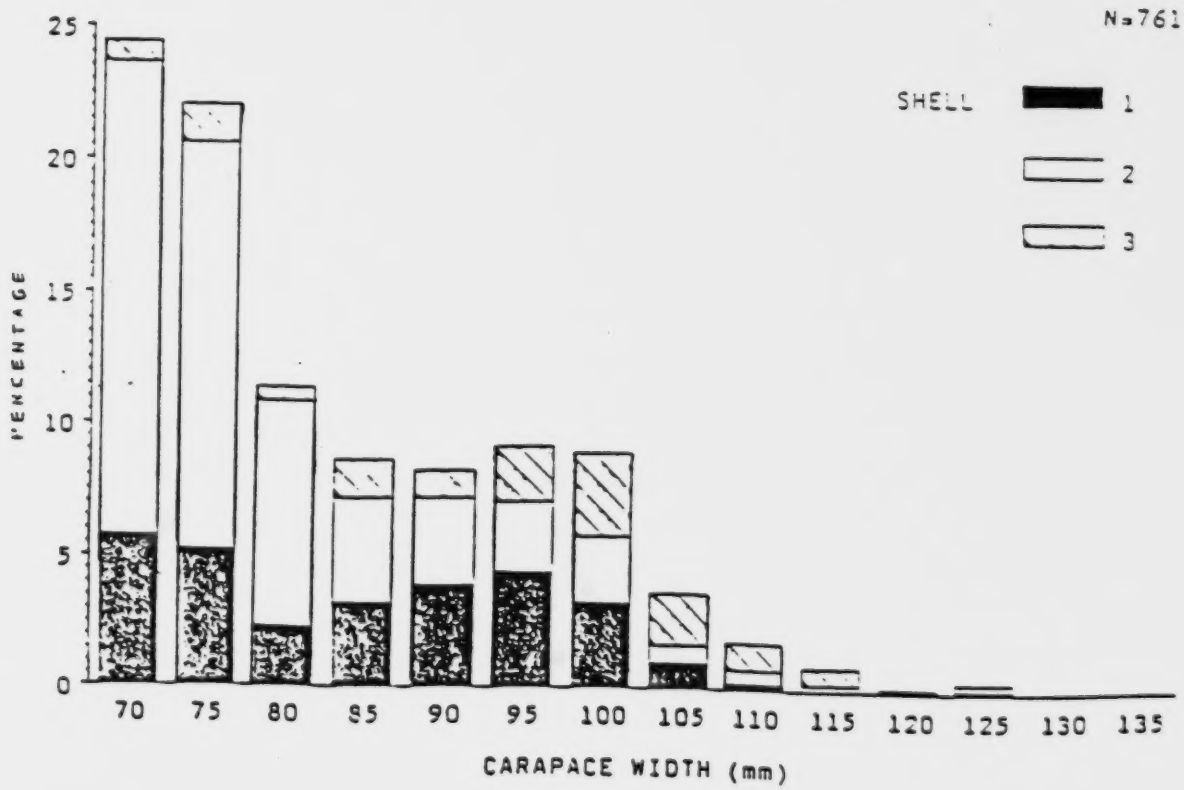


Fig.4. Snow crab research sample from Downing Basin, May,1989.

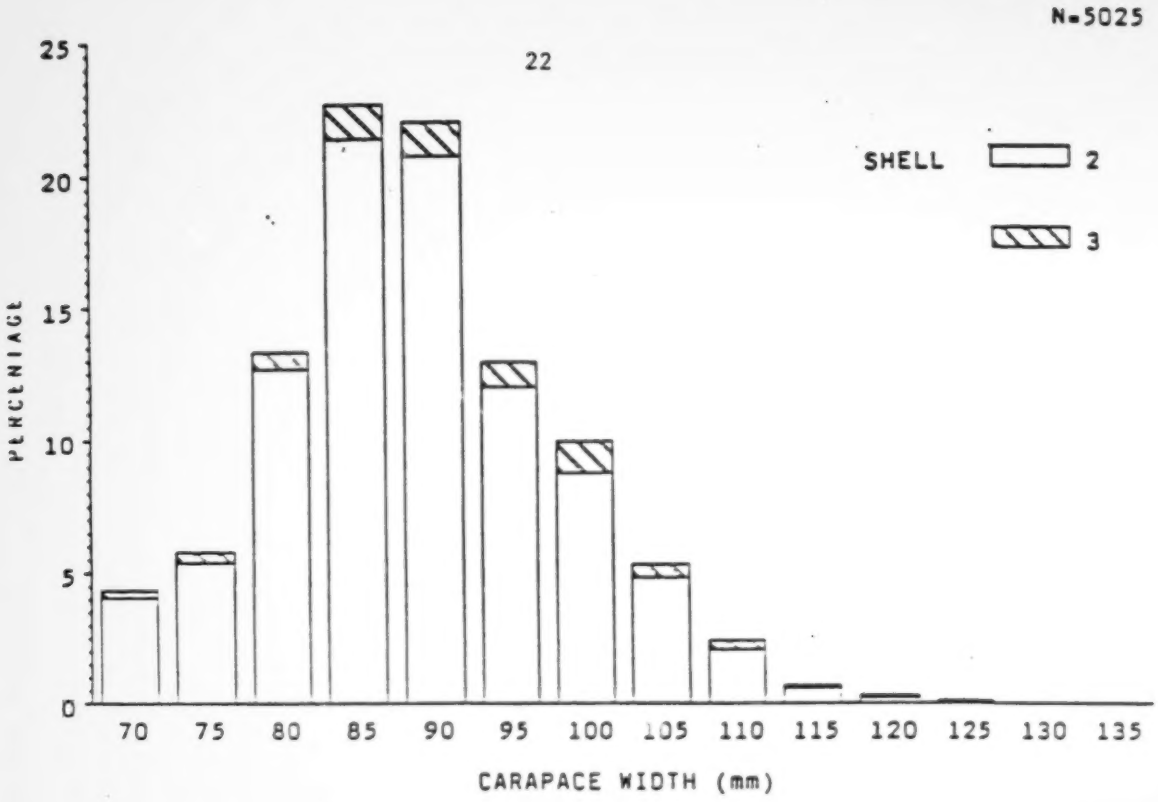


Fig.5 . Snow crab research sample from Inshore Avalon Peninsula, May,1989.

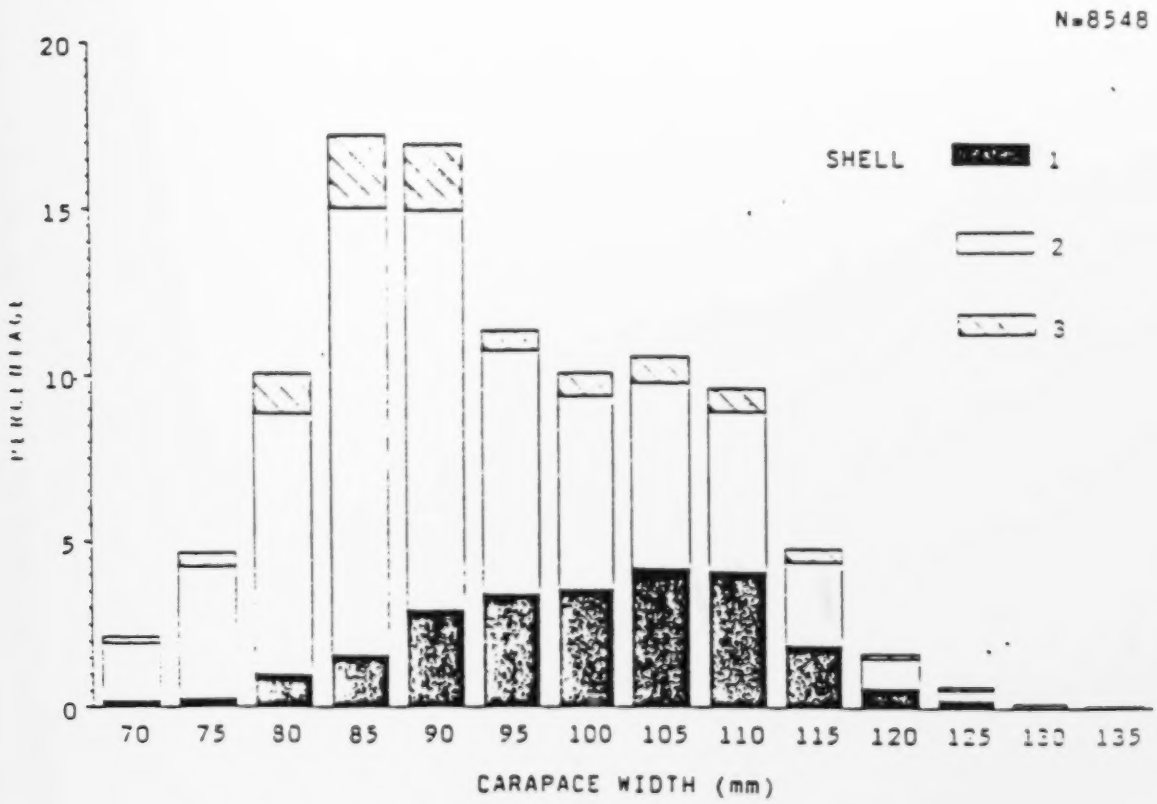


Fig.6 . Snow crab research sample from Bonavista Bay, August, 1989.

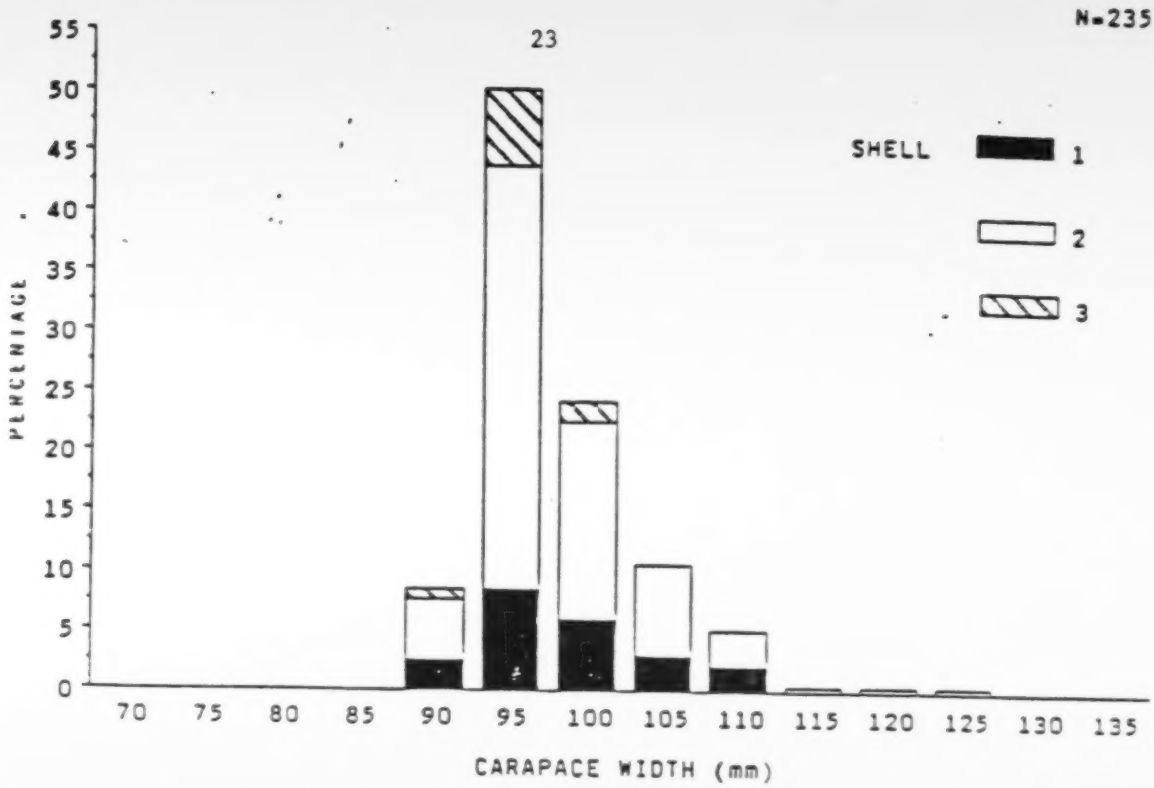


Fig. 7 . Snow crab commercial plant sample from St. Mary's Bay, Fall-1989.

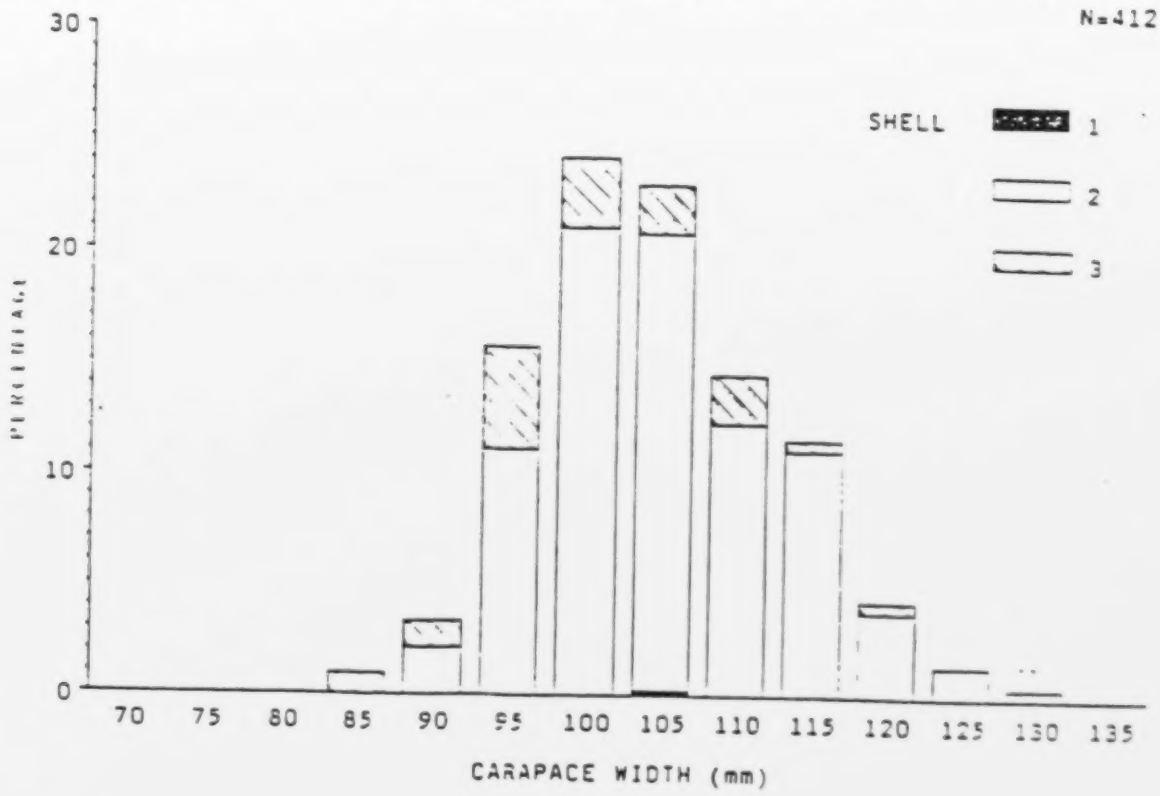


Fig. 8 . Snow crab commercial plant sample from Southern Avalon, Spring- 1989.

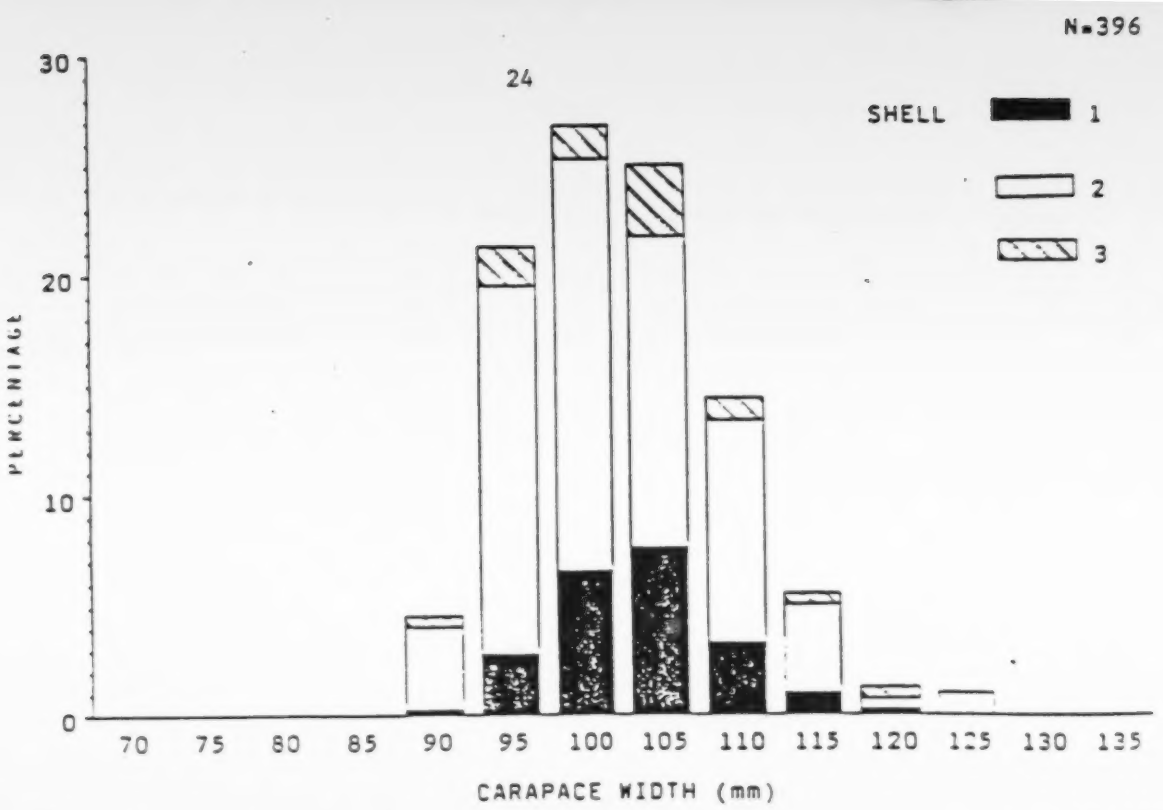


Fig.9. Snow crab commercial plant sample from Conception Bay, Fall,1989.

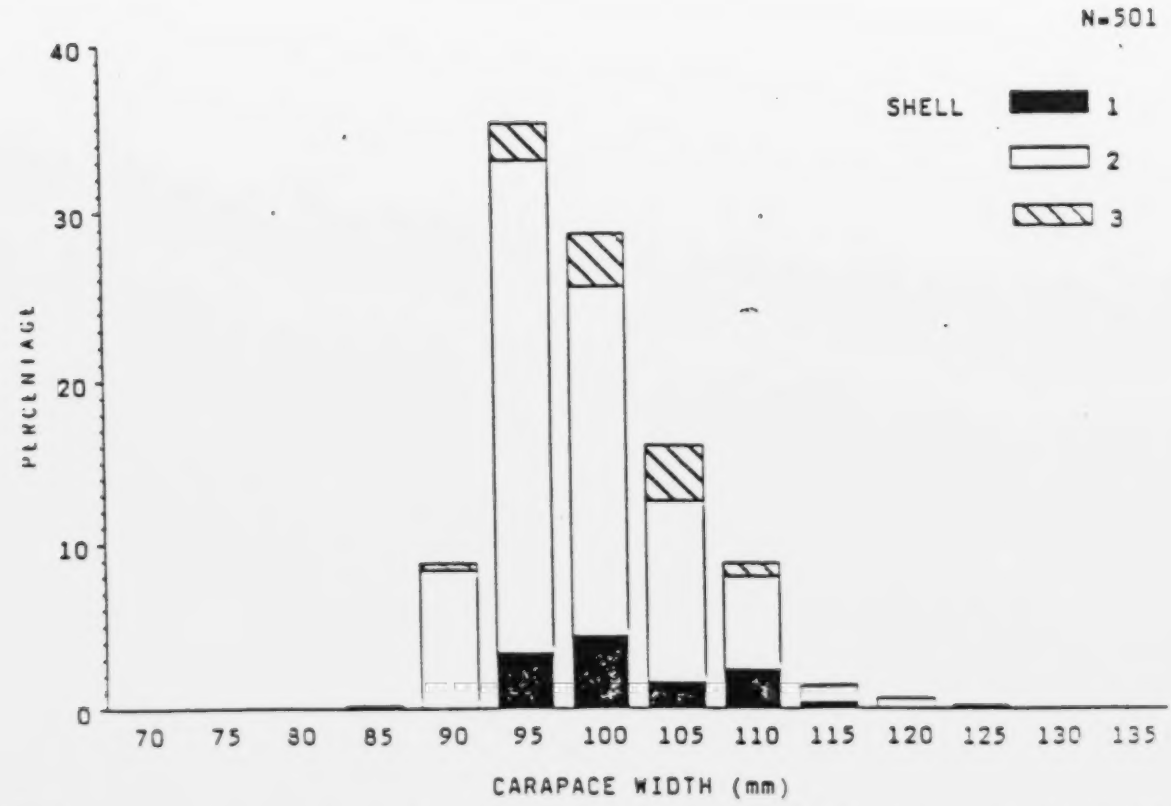


Fig.10 Snow crab commercial plant sample from Offshore Avalon,Fall,1989.

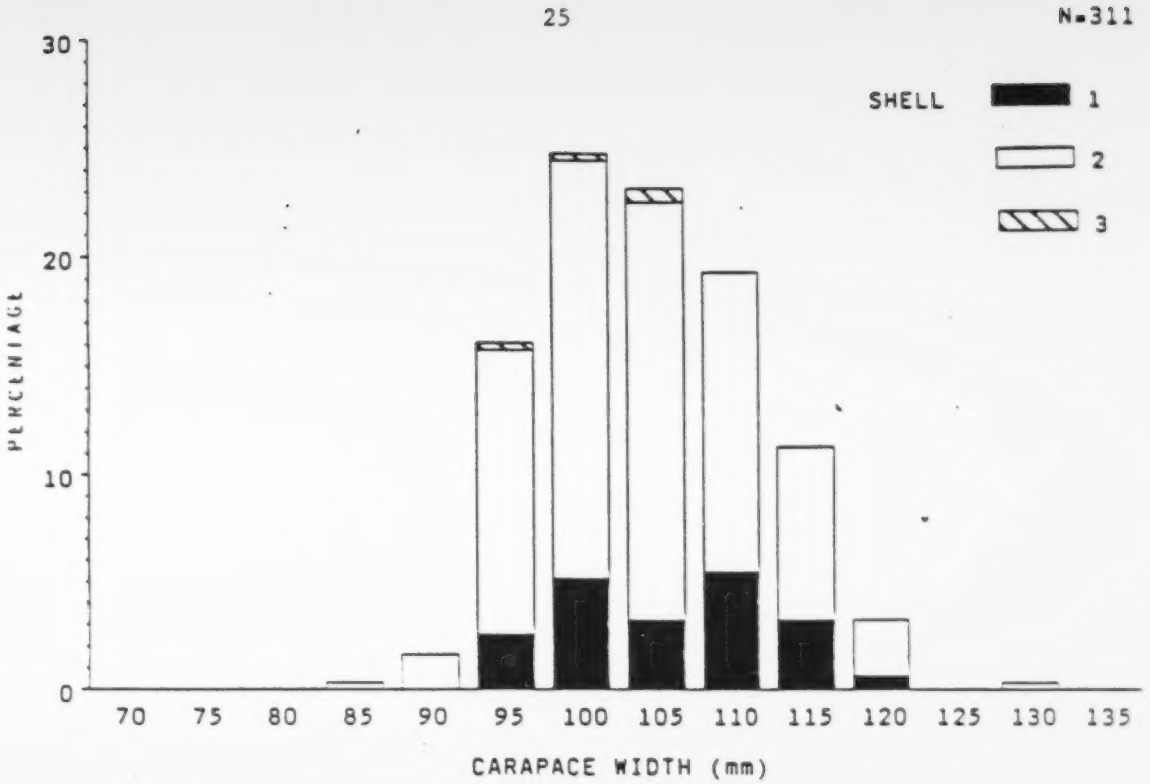


Fig.11. Snow crab commercial plant sample from Fogo-Twillingate,Fall,1989.

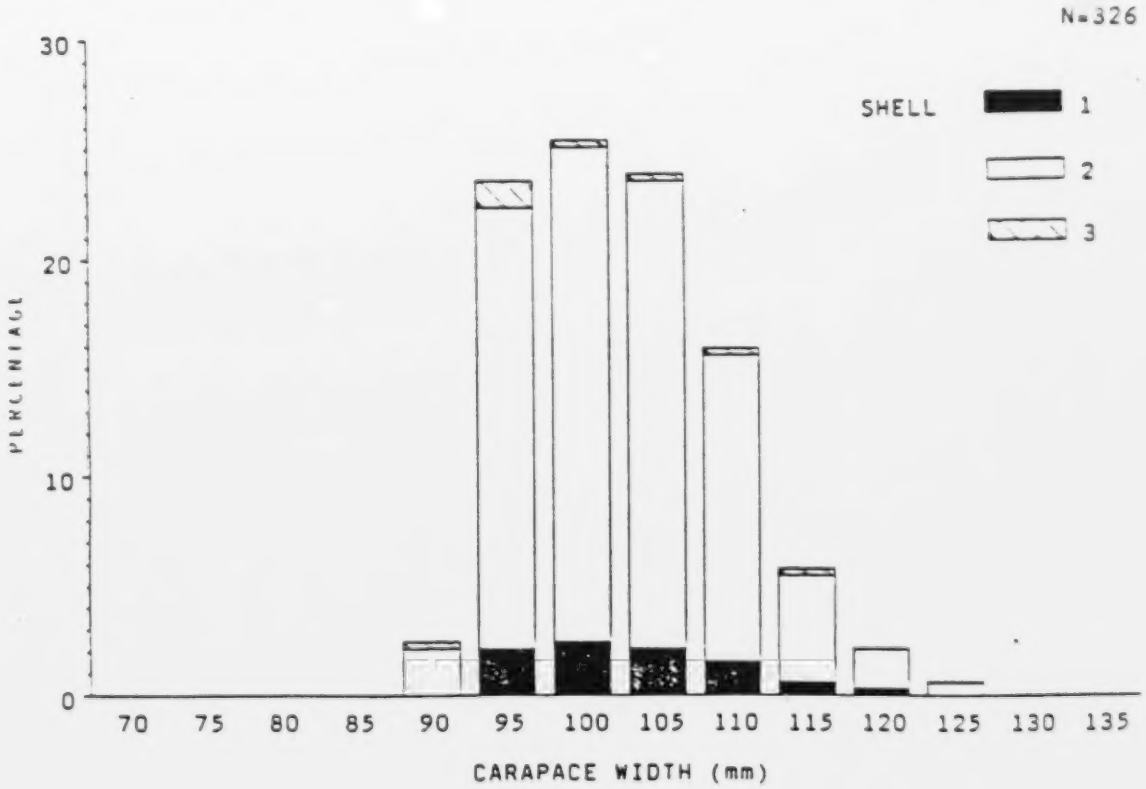


Fig.12. Snow crab commercial plant sample from Notre Dame Bay,Fall,1989.

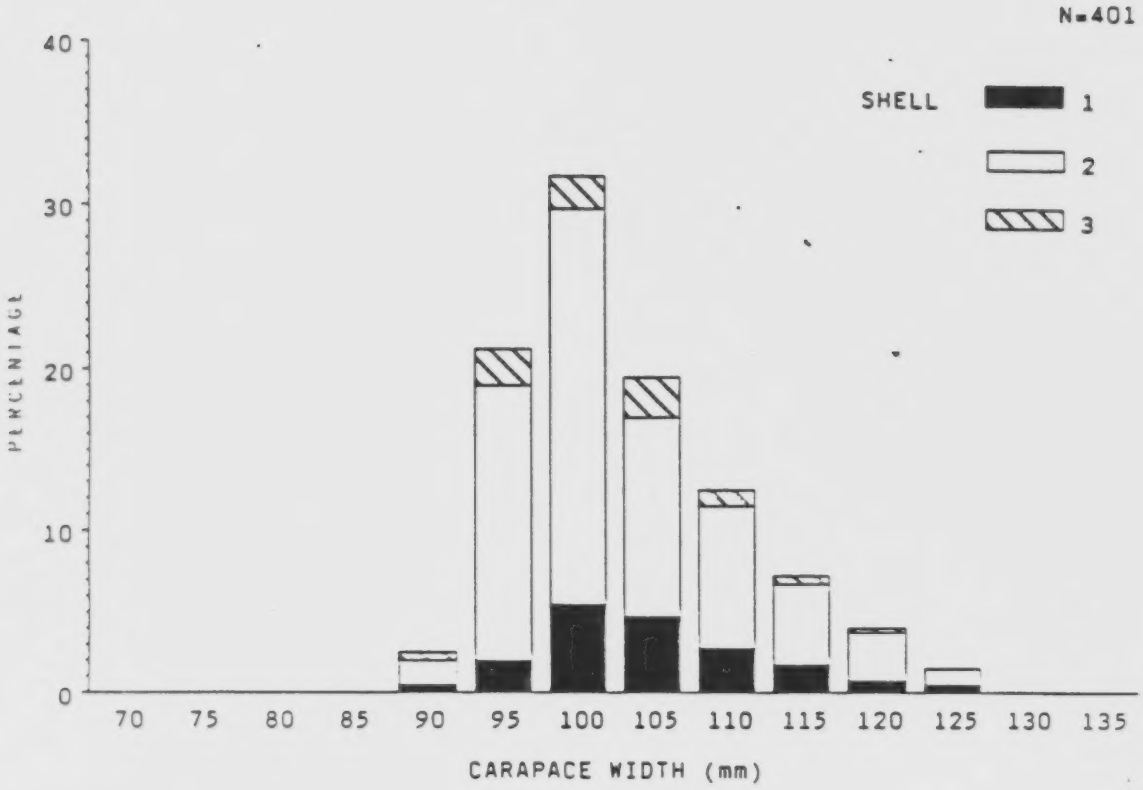


Fig.13. Snow crab commercial plant sample from White Bay, Fall, 1989.

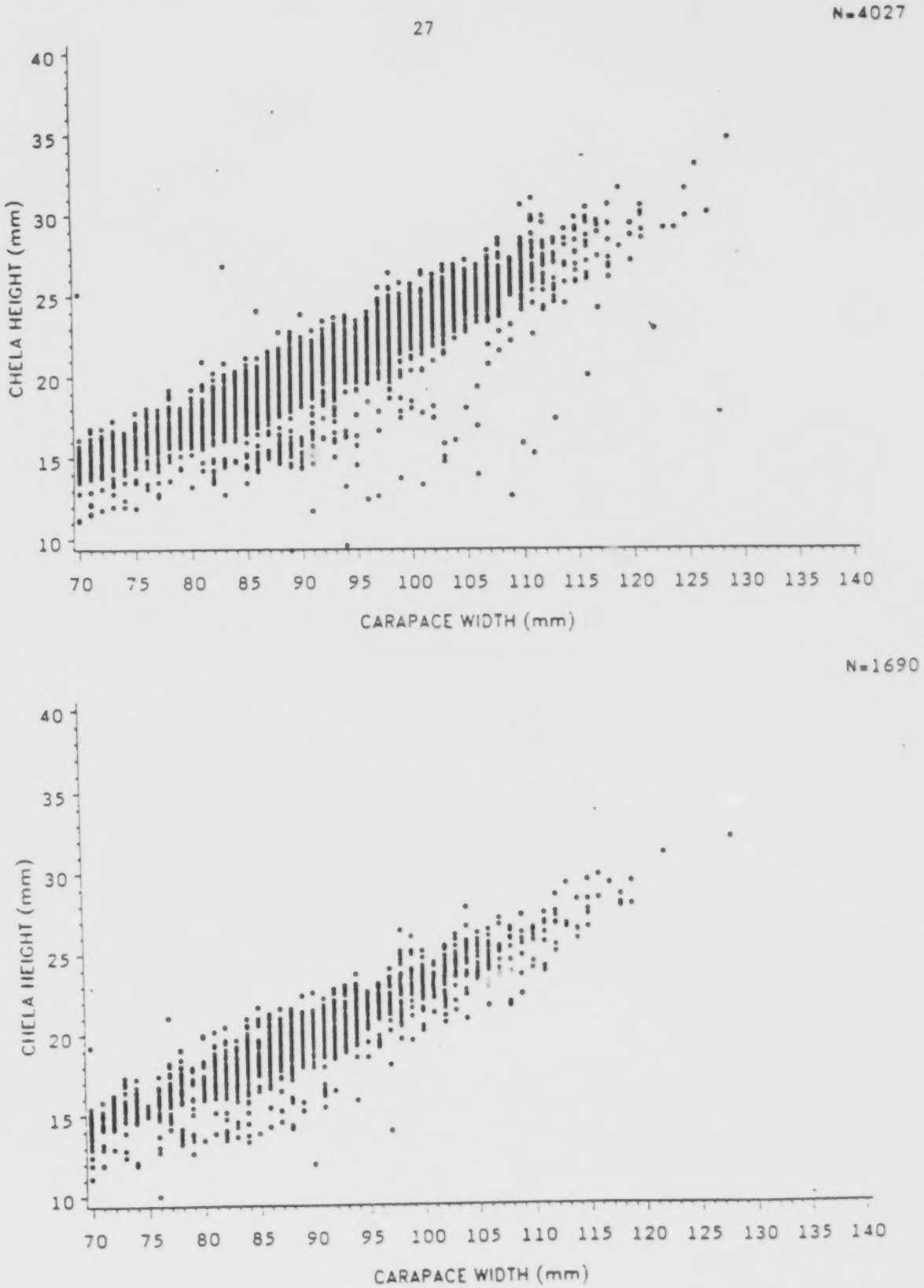
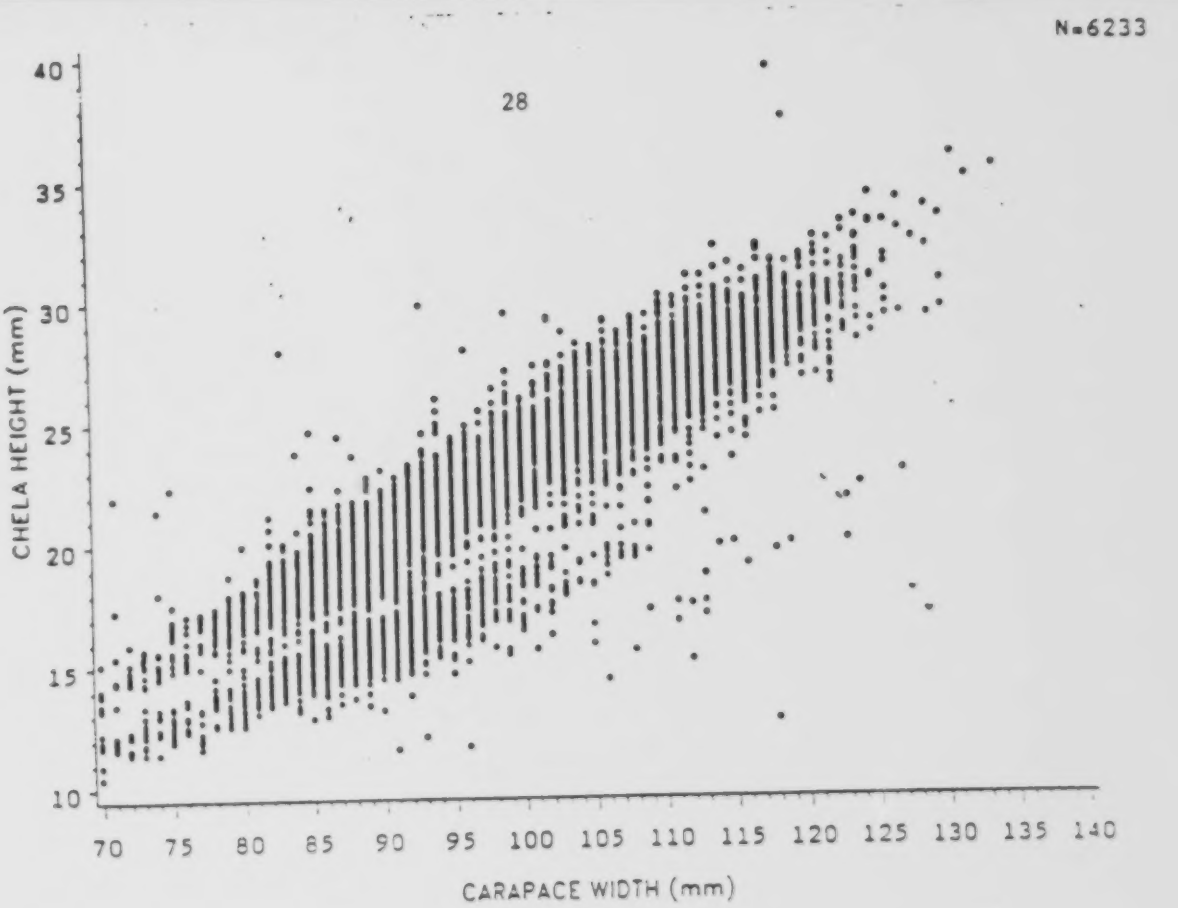


Fig.14. Comparison of snow crab carapace width versus chela height from research samples collected from Inshore Avalon, 1988-1989.



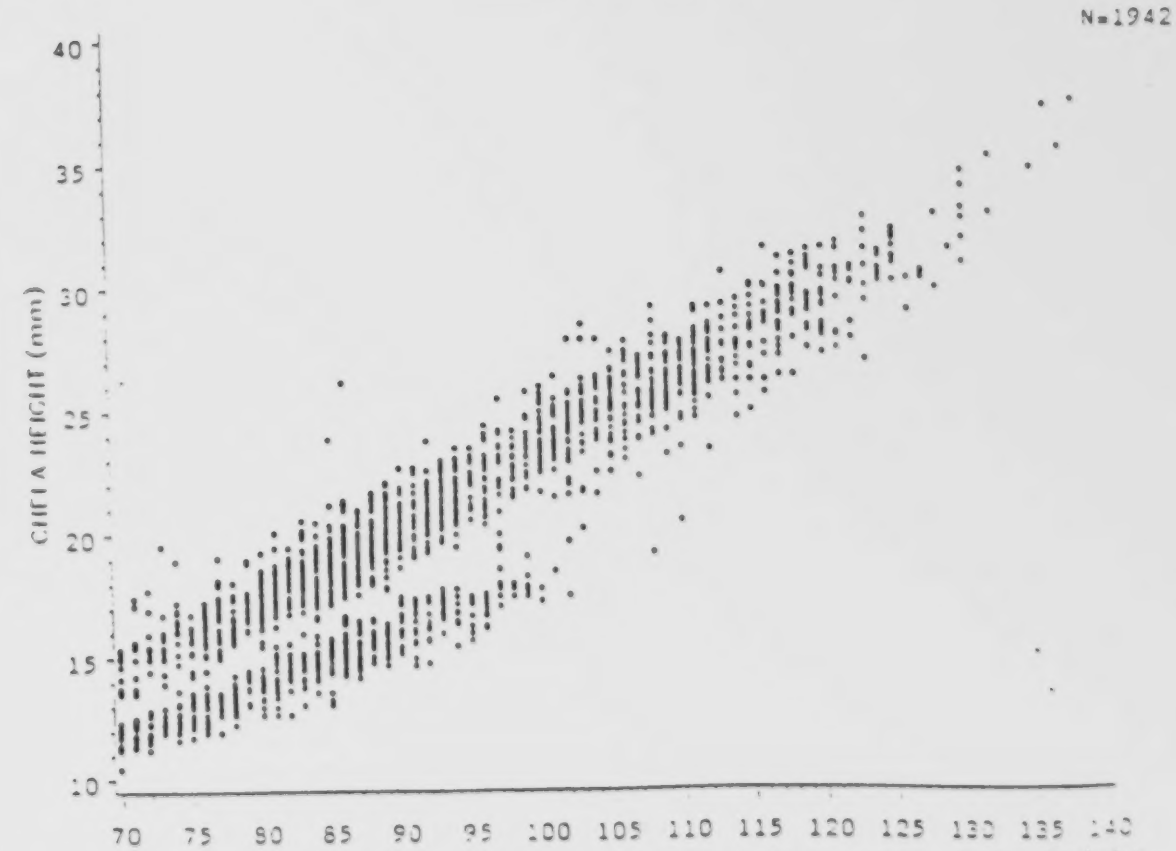


Fig.15. Comparison of snow crab carapace width versus chela height from research samples collected from Bonavista Bay, 1988-1989.

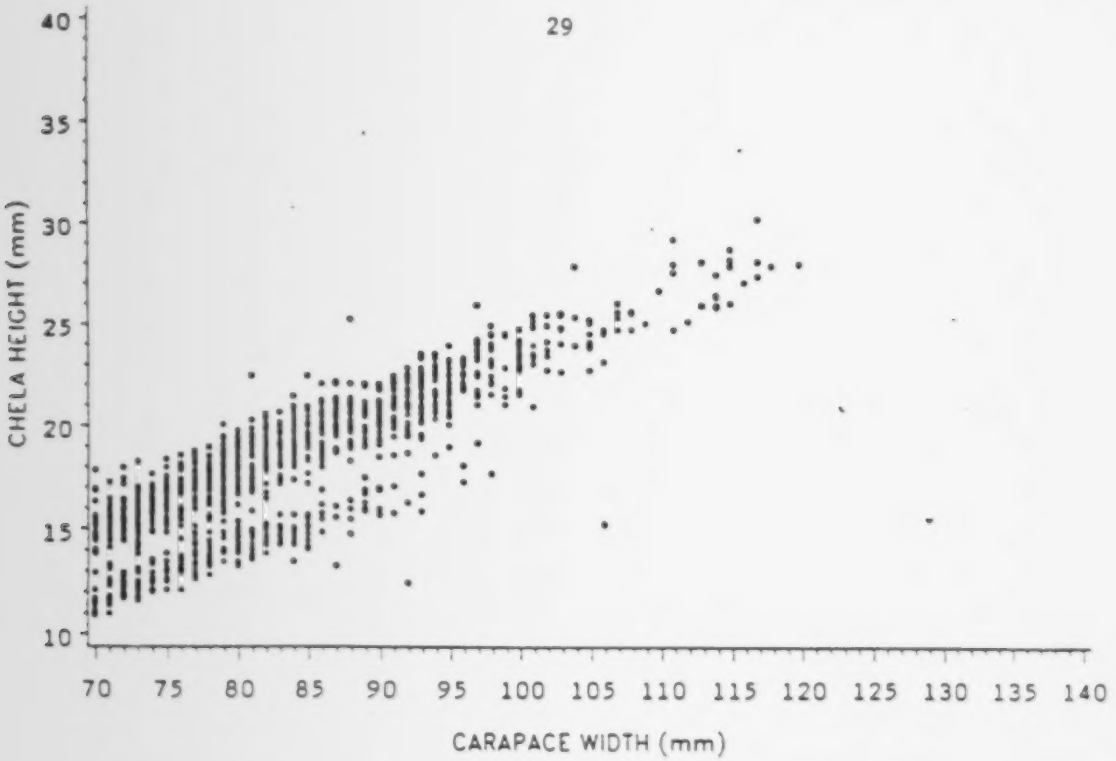


Fig.16. Summary of snow crab carapace width versus chela height from samples collected from Offshore Avalon Peninsula, May, 1989.

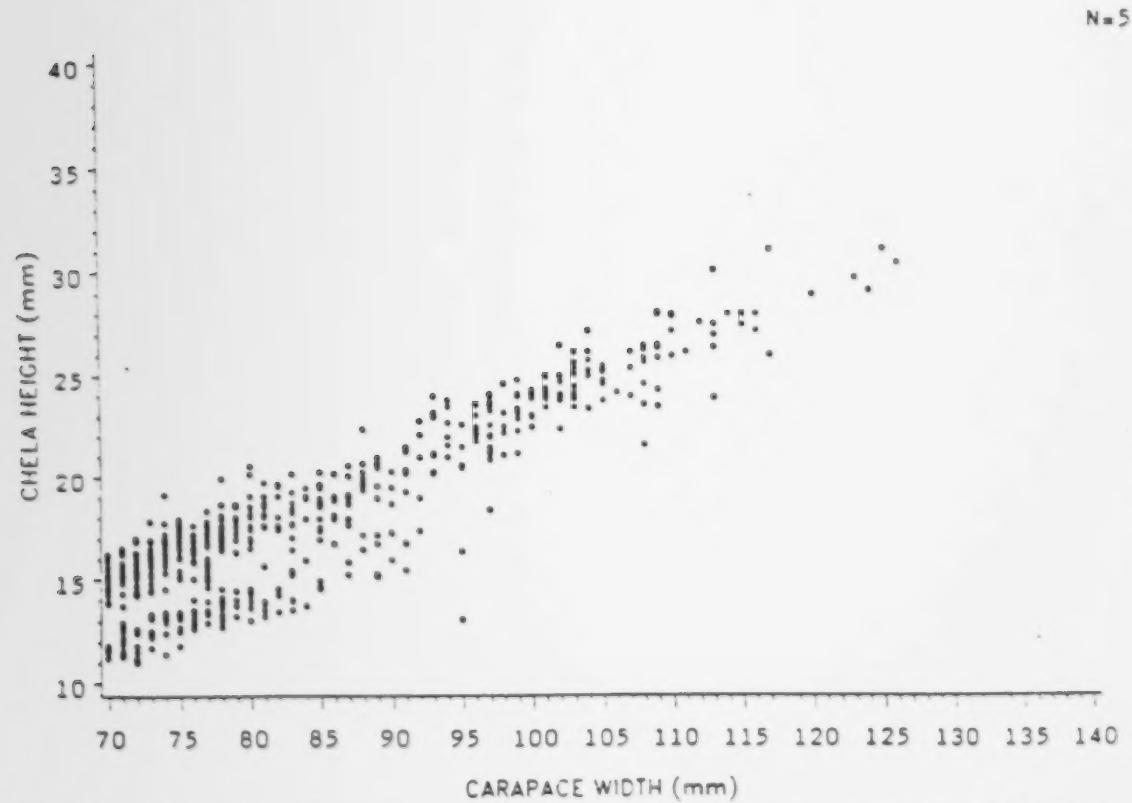


Fig.17. Summary of snow crab carapace width versus chela height from research samples collected from Downing Basin, May, 1989.